Montana Early Warning System

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1/16/2014

What Is the Montana EWS?

- A statistical model that can use readily available school, student, and other data to identify students who are at risk of dropping out of school **before** they drop out.
  - The EWS allows educators to intervene early on during the process before a student has reached the point of no return.

How is the EWS developed?

- Compare data from dropouts to the data from high school graduates from the school years 2007-2013

- Model is found using Logistic Regression

$$\pi(x) = \frac{e^{\alpha+\beta x_1+\beta x_2+\cdots+\beta x_n}}{1 + e^{\alpha+\beta x_1+\beta x_2+\cdots+\beta x_n}}$$

  - $\pi(x)$ is the percent chance a student will drop out of school

- Separate model is developed for each grades 7 and 8 and for each year of high school.

What data is available for the model?

- Data stored by the State.
  - Student Data
    - AIM Data
    - Testing Data
  - School data
    - School Demographics
    - Location
  - Census Information
    - Unemployment Rates
    - Populations

- Data stored by the Schools
  - Attendance
  - Transcripts
  - Grades
  - Behavior Events

Pilot Study

- School Systems
  - Arlee
  - Belgrade
  - Butte
  - Havre
  - Lame Deer
  - Laurel
  - Lewistown
  - Livingston
  - Townsend
  - Wolf Point

- Great Falls participated during the 2012-2013 school year.
- For the 2012-2013 school year EWS Results were sent to each school for their students once a month, at the beginning of each month.
- EWS was changed and updated many times during the school year.
  - Model was left unchanged since March
  - Model was updated this past summer and will remain unchanged throughout the 2013-2014 school year.

Example EWS Results

SC	SchoolName	LE	LastName	FirstName	StateID	HSYears	Grade	DropoutProb	Change	Est.	Reasons
0499	Pleasantville School	0123	Anderson	Joel	12345678	5	12	36.0%		*	Attendance Previous Grades Age Off Track Mobile
0499	Pleasantville School	0123	Smith	Maria	12345678	4	12	25.0%			Attendance Behavior LEP
0499	Pleasantville School	0123	Lackey	Edin	12345678	4	12	0.1%			
0499	Pleasantville School	0123	Underman	Hal	12345678	3	11	15.6%			Attendance
0499	Pleasantville School	0123	Hinch	Joe	12345678	3	11	1.4%		*	Behavior
0499	Pleasantville School	0123	Grossman	Keith	12345678	3	11	0.8%			Special Ed
0499	Pleasantville School	0123	Caligher	Mary	12345678	2	10	72.3%			Attendance Current Grades Age Off Track
0499	Pleasantville School	0123	Stein	Thomas	12345678	2	10	34.5%			Attendance Age
0499	Pleasantville School	0123	Banby	Shane	12345678	2	9	10.0%			Behavior OffTrack LEP
0499	Pleasantville School	0123	Thompson	Jess	12345678	1	9	1.5%			Current Grades
0499	Pleasantville School	0123	Smith	Jane	12345678	0	8	6.5%			Attendance
0499	Pleasantville School	0123	Anderson	Mike	12345678	0	8	0.4%			Attendance Age
0499	Pleasantville School	0123	Player	Troy	12345678	0	8	0.3%			Mobile
0499	Pleasantville School	0123	Cornrow	Mike	12345678	0	7	4.3%		*	Current Grades Previous Grades
0499	Pleasantville School	0123	Abbott	Megan	12345678	0	7	0.2%			Current Grades

Reasons that can be listed: Attendance, Current Grades, Previous Grades, Age, Off Track, Behavior, LEP, Mobile, Special Ed

Variables that are in the EWS Model

Collected by OPI

- Special Ed Status (Y or N)
- Ever been LEP (Y or N)
- Moved this school year (Y or N)
- Moved from out of state (Y or N)
- Moved from out of state this year (Y or N)
- Age Difference *
- # of School Systems attended since 2007

About 200 Variables have been analyzed.

* Variable is included in all models

Not Collected by OPI

- Attendance Rate *
- # of Previous Year D and F Grades
- More than 1 Sixth Grade F (Y or N)
- # of Previous Term F's
- # of Previous Term A's *
- # of Freshman Year F's
- # of previous Term Tardies
- # of Previous Term Absences *
- # of Behavior Events in last 120 days *
- # of Out of School Suspension Events in last 3 years
- Freshman Year GPA *
- Cumulative GPA *
- On Track (Y or N) *
- # of Credits per year *
- # of Tardies in last 60 days
- # of Absences in last 60 days

Two Parts to a good EWS Model

1

- The Model should assign a high dropout percentage to students who end up dropping out.
  - Low dropout percentage to those that eventually graduate.
    - Can be evaluated by:
      - R squared
      - C-statistic
      - ROC Curves
      - Model AIC

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- Model should be efficient in identifying dropouts above the cut-off threshold for targeting a student as At-Risk
  - A high percentage of At-Risk students end up being dropouts.
    - Can be evaluated by:
      - Confusion Matrix

When is a student considered At Risk?

- At what dropout percentage should we be concerned about a student?
  - Depends on school
  - Depends on how many incorrect conclusions you will accept.

True Negative **Model: Graduate** **Student: Graduate**	**False Negative** **Model: Graduate** **Student: Dropout**
False Positive **Model: Dropout** **Student: Graduate**	**True Positive** **Model: Dropout** **Student: Dropout**

- We want to be able to identify as many dropouts as we possibly can.
- We want as many of the students as possible to be in one of the "True" boxes.
  - Small number of students in the "False" boxes.

EWS Model Examples

FirstName	DropoutProb	Dropout
Joel	36.0%	Y
Maria	25.0%	
Edin	0.1%	
Hal	15.6%	Y
Joe	1.4%	
Keith	0.8%	
Mary	72.3%	Y
Thomas	34.5%	Y
Shane	10.0%	
Jess	1.5%	
Jane	6.5%	
Mike	0.4%	
Troy	0.3%	
Mike	4.3%	
Megan	0.2%	

True Negative **Model: Graduate** **Student: Graduate** **0** **0%**	**False Negative** **Model: Graduate** **Student: Dropout** **0** **0%**
False Positive **Model: Dropout** **Student: Graduate** **6** **60%**	**True Positive** **Model: Dropout** **Student: Dropout** **4** **40%**

- All Students are marked as At Risk
  - Dropouts found - 100%
  - Graduates found - 0%
  - Accuracy - 40%

EWS Model Examples

FirstName	DropoutProb	Dropout
Joel	36.0%	Y
Maria	25.0%	
Edin	0.1%	
Hal	15.6%	Y
Joe	1.4%	
Keith	0.8%	
Mary	72.3%	Y
Thomas	34.5%	Y
Shane	10.0%	
Jess	1.5%	
Jane	6.5%	
Mike	0.4%	
Troy	0.3%	
Mike	4.3%	
Megan	0.2%	

True Negative **Model: Graduate** **Student: Graduate** **6** **60%**	**False Negative** **Model: Graduate** **Student: Dropout** **4** **40%**
False Positive **Model: Dropout** **Student: Graduate** **0** **0%**	**True Positive** **Model: Dropout** **Student: Dropout** **0** **0%**

- No Students are marked as At Risk
  - Dropouts found - 0%
  - Graduates found - 60%
  - Accuracy - 60%

EWS Model Examples

FirstName	DropoutProb	Dropout
Joel	36.0%	Y
Maria	25.0%	
Edin	0.1%	
Hal	15.6%	Y
Joe	1.4%	
Keith	0.8%	
Mary	72.3%	Y
Thomas	34.5%	Y
Shane	10.0%	
Jess	1.5%	
Jane	6.5%	
Mike	0.4%	
Troy	0.3%	
Mike	4.3%	
Megan	0.2%	

True Negative **Model: Graduate** **Student: Graduate** **5** **50%**	**False Negative** **Model: Graduate** **Student: Dropout** **1** **10%**
False Positive **Model: Dropout** **Student: Graduate** **1** **10%**	**True Positive** **Model: Dropout** **Student: Dropout** **3** **30%**

- Marked as At Risk when >20%
  - Dropouts found - 75%
  - Graduates found - 83%
  - Accuracy - 80%

EWS Model Examples

FirstName	DropoutProb	Dropout
Joel	36.0%	Y
Maria	25.0%	
Edin	0.1%	
Hal	15.6%	Y
Joe	1.4%	
Keith	0.8%	
Mary	72.3%	Y
Thomas	34.5%	Y
Shane	10.0%	
Jess	1.5%	
Jane	6.5%	
Mike	0.4%	
Troy	0.3%	
Mike	4.3%	
Megan	0.2%	

True Negative **Model: Graduate** **Student: Graduate** **5** **50%**	**False Negative** **Model: Graduate** **Student: Dropout** **0** **0%**
False Positive **Model: Dropout** **Student: Graduate** **1** **10%**	**True Positive** **Model: Dropout** **Student: Dropout** **4** **40%**

- Marked as At Risk when >15%
  - Dropouts found - 100%
  - Graduates found - 83%
  - Accuracy - 90%

EWS Model Examples

Looking at Beginning of the Year EWS Results from 2009-2010

Only including students that had **all** data elements needed for the EWS. (3030 students total)

Must look at 2009-2010 to include 9th, 10th, 11th, and 12th grade students and allow time for them to graduate.

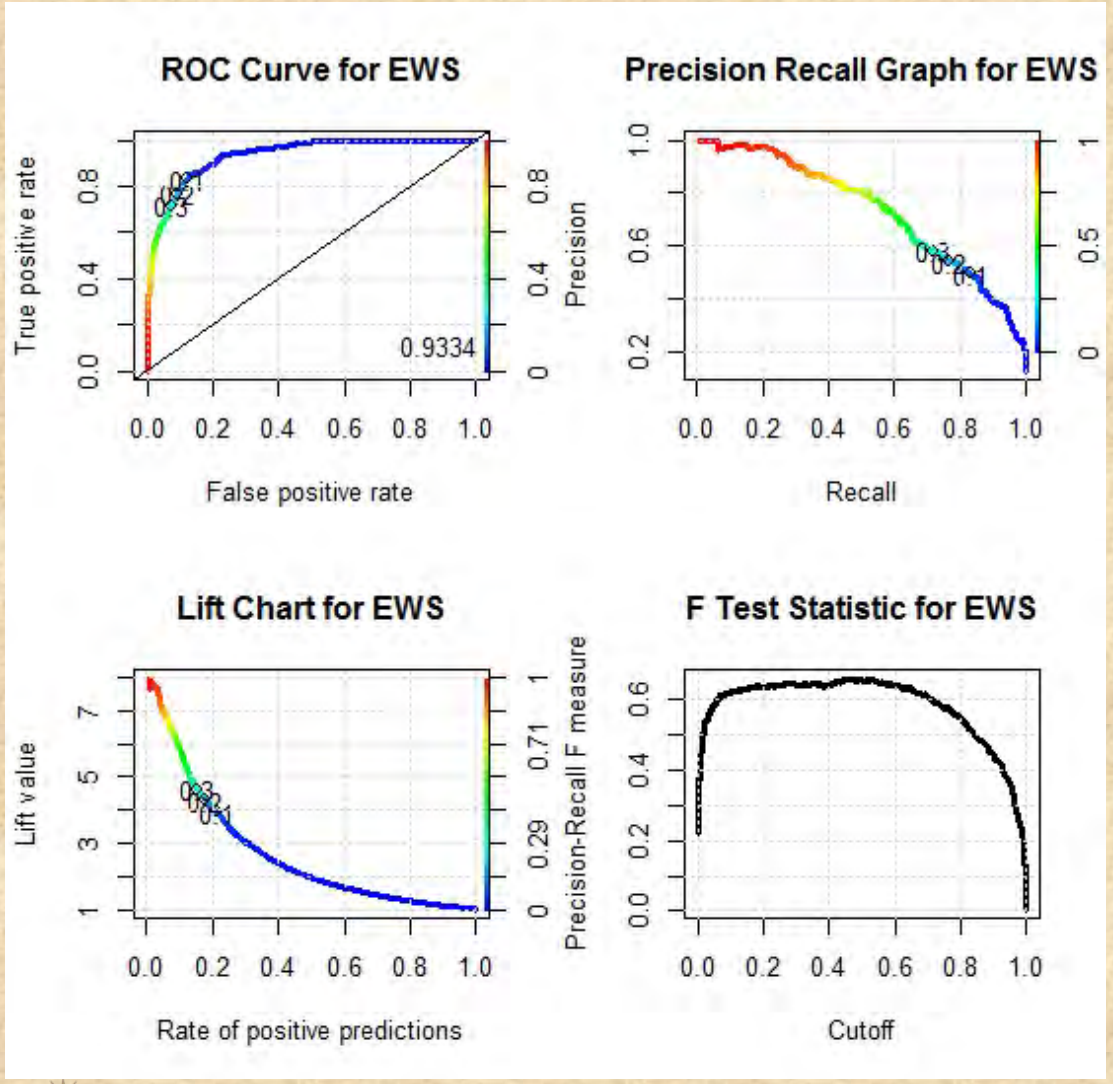
380 Dropouts from group of students that were in high school in 2009-2010 in the Pilot Schools

True Negative **Model: Graduate** **Student: Graduate** **2364** **78.0%**	**False Negative** **Model: Graduate** **Student: Dropout** **77** **2.5%**
False Positive **Model: Dropout** **Student: Graduate** **286** **9.4%**	**True Positive** **Model: Dropout** **Student: Dropout** **303** **10.0%**

- Marked as At Risk when >15%
  - Dropouts found – 79.7%
  - Graduates found – 89.2%
  - Accuracy – 88.0%

EWS Model Diagnostics

- ROC Curve and c-statistic
  - Probability the model will assign a higher score to a randomly chosen dropout that to a randomly chosen graduate.
- Precision Recall Graph
  - Vertical Axis – Percentage of at risk individuals are dropouts
  - Horizontal Axis – Percentage of dropouts the model finds.
- Lift Chart and F Test Statistic
  - Help find the best cutoff value for a student being at risk.



Full Model Diagnostics

- R-squared
  - Measure of the fit of the model to data
  - Works a little different with logistic regression but similar to the r squared used with linear regression
- C-statistic
  - Probability a higher dropout value is assigned to a dropout than to a graduate.

Year	R squared	c-stat
7th Grade	0.562	0.906
8th Grade	0.562	0.914
1st Year HS	0.669	0.940
2nd Year HS	0.710	0.956
3rd Year HS	0.717	0.968
4th Year HS	0.741	0.982

2013-2014 School Year EWS Results

- Median Dropout percentage for all students in pilot schools is 7.5%

- 177 Dropouts at Pilot Schools this year so far (as of 1/9/14) that had EWS results before the start of the year.
  - 236 Dropouts total with EWS results

- Only 31 or about 17.5% of the dropouts had dropout percentages of less than 15%
  - Would not have been targeted as At-Risk

- Most had much higher percentages.
  - Median Dropout Percentage of 88 dropouts was 61.7%
  - 62 of the 177 had over 90%

Coming Soon?

- EWS to be placed on GEMS for the entire state to use
  - Will require upload of some data
    - Data will be deleted and not stored
  - Hopefully before the start of the 2014-2015 school year. Process has already been started
  - Will include data so you can also look at district wide dropout percentages.
    - By School
    - By Grade
- Develop a similar model for younger students
  - 3rd – 5th grade students
    - Model for proficient scores on Statewide Assessment for 6th grade year.
  - 6th – 8th grade students
    - Model for passing all courses as a first year high school student.
  - 9th -12th grade students
    - Continue EWS model for dropouts

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